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though the planet afforded, from 16h to 18h in the morning of three days of October, a most splendid view. On the contrary, it seemed with daybreak to be more easy to see the faint illumination near the terminator, even to two-thirds of the whole breadth of the dark part of *Venus*.

*Prague, February* 17, 1877.

## *Measures of α Centauri*, 1870 to 1877.

By H. C. Russell, Esq., Director of the Sydney Observatory.

As the double star *α Centauri* did not arrive at periastron in 1875 as predicted, perhaps the following measures of this interesting double, taken during the ordinary course of my observations on southern double stars, during the past seven years, may not be without interest. It is evident from these observations that $\alpha^2$ will not make its nearest approach to $\alpha^1$ until about the end of this year. Its predicted arrival at that point was therefore nearly three years in error. It is my intention to observe it closely during the next few months; and I hope to obtain such a series of measures as may serve to determine its periastron with accuracy. Some correction may be necessary to my position-angles, on account of *personal bias*, for I find that I do not measure the angle the same when the telescope is east as I do when it is west of the pier (see observations of July 20 and July 24, 1877), but I have not time to investigate the amount before this mail closes.

The observations from 1870 to 1874 were made with a $7\frac{1}{4}$-in. refractor by Merz, of 10 ft. 4 in. focus, and very fine defining power. The remainder have been made with an $11\frac{1}{2}$-in. refractor by Schroeder, a very fine instrument. The method of observing is to place the position-wire bisecting both stars, and then make the distance wires bisect them. After reading, the position-wire is turned right away, and brought back again, and the distance wires crossed; each observation, therefore, which follows is an independent determination of the distance and position-angle. The only exception is the series September 27, 1870, when the position-circle was not moved after it was set the first time.

All the observations, except those in 1870, were taken when the star was near the meridian.

*Results of Measures of Double Star α Centauri, at the Sydney Observatory.*

| Date. | Position-Angle. | | Distance. | Remarks. |
|---|---|---|---|---|
| 1870 | ° | ′ | ″ | |
| Sept. 27 | 21 | 58 | 10·0 | Definition good; stars have sharp round disks; telescope $7\frac{1}{4}$ inches; P. 230; aperture 3 inches. |
| | 21 | 58 | 11·0 | |
| | 21 | 58 | 10·7 | |
| | 21 | 58 | 10·7 | |
| | 21 | 58 | 9·6 | |
| Means | 21 | 58 | 10·40 | |

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| Date. | Position-Angle. | | Distance. | Remarks. |
|---|---|---|---|---|
| 1870 | ° | ′ | ″ | |
| Sept. 28 | 23 | 24 | 10·3 | Light clouds about; stars very unsteady; telescope 7¼; power 150. |
| | 24 | 17 | 10·3 | |
| | 21 | 44 | 10·3 | |
| | 21 | 55 | 11·0 | |
| Means | 22 | 50 | 10·47 | |
| Oct. 3 | 22 | 5 | 10·1 | Fine clear night; "moonlight"; telescope 7¼; power 150. |
| | 22 | 30 | 10·4 | |
| | 22 | 11 | 10·3 | |
| | 22 | 16 | 10·3 | |
| | 22 | 43 | 10·2 | |
| Means | 22 | 21 | 10·26 | |
| Oct. 5 | 21 | 40 | 10·8 | Strong wind; much vibration; telescope 7¼; power 150. |
| | 21 | 58 | 11·0 | |
| | 22 | 28 | 10·3 | |
| | 21 | 44 | 10·3 | |
| | 22 | 36 | 11·1 | |
| Means | 22 | 5 | 10·70 | |
| 1871<br>June 3 | 23 | 20 | 10·60 | Power 230; telescope 7¼. |
| | 21 | 42 | 10·31 | |
| | 23 | 13 | 10·23 | |
| | 23 | 11 | 10·27 | |
| | 22 | 13 | 10·05 | |
| | 23 | 49 | 10·46 | |
| | 23 | 8 | 10·05 | |
| | 22 | 52 | 10·03 | |
| | 22 | 33 | 10·34 | |
| | 23 | 3 | 10·16 | |
| Means | 22 | 44 | 10·25 | |
| July 13 | 22 | 57 | 10·05 | Stars dancing a good deal; telescope 7¼. |
| | 23 | 15 | 10·16 | |
| | 22 | 47 | 9·86 | |
| | 23 | 23 | 9·82 | |
| | 23 | 5 | 10·21 | |
| Means | 23 | 5 | 10·2 | |

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| Date. | Position-Angle. | | Distance. | Remarks. |
|---|---|---|---|---|
| 1872 | ° | ′ | ″ | |
| June 7 | 26 | 13 | 9·95 | Very thick fog; at times scarcely visible; telescope 7¼; power 150. |
| | 25 | 43 | 9·82 | |
| | 26 | 3 | 9·69 | |
| | 25 | 40 | 9·84 | |
| | 25 | 58 | 9·73 | |
| | 25 | 48 | 9·75 | |
| Means | 25 | 54 | 9·80 | |
| July 5 | 25 | 0 | 9·62 | Stopped by clouds; measures good; telescope 7¼; power 150. |
| | 24 | 46 | 9·75 | |
| | 24 | 30 | 9·62 | |
| Means | 24 | 45 | 9·66 | |
| 1873 | | | | |
| May 2 | 28 | 52 | 9·45 | Stars dancing; aperture of 3 inches; power 333; telescope 7¼. |
| | 28 | 45 | 9·45 | |
| | 27 | 56 | 9·66 | |
| | 28 | 17 | 9·66 | |
| | 27 | 59 | 9·36 | |
| | 28 | 37 | 9·40 | |
| Means | 28 | 4 | 9·50 | |
| 1874 | | | | |
| June 13 | 30 | 16 | 7·80 | Good definition; measures good; power 140; telescope 7¼. |
| | 30 | 26 | 7·67 | |
| | 29 | 33 | 7·76 | |
| | 29 | 21 | 7·63 | |
| | 30 | 19 | 7·69 | |
| | 30 | 13 | 7·84 | |
| | 30 | 6 | 7·50 | |
| | 30 | 3 | 7·56 | |
| | 30 | 21 | 7·76 | |
| | 29 | 29 | 7·89 | |
| Means | 29 | 59 | 7·71 | |

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| Date. | Position-Angle. | | Distance. | Remarks. |
|---|---|---|---|---|
| 1874 | ° | ′ | ″ | |
| June 29 | 30 | 19 | 8·19 | Good definition; full moon; measures of distance not good; power 140; telescope 7¼. |
| | 30 | 12 | 8·17 | |
| | 30 | 0 | 7·93 | |
| | 30 | 8 | 8·21 | |
| | 30 | 9 | 8·08 | |
| | 29 | 53 | 8·34 | |
| | 30 | 5 | 8·45 | |
| | 29 | 44 | 8·10 | |
| | 29 | 50 | 8·47 | |
| | 29 | 58 | 8·32 | |
| Means | 30 | 2 | 8·23 | |
| 1875 | ... | | ... | Observer away in Europe. |
| 1876 | | | | |
| May 23 | 45 | 5 | 4·39 | Stars tremulous, and very watery; power 180; aperture 6 inches; first measures with 11½ inches. |
| | 46 | 30 | 4·52 | |
| | 46 | 0 | 4·62 | |
| | 46 | 15 | 4·55 | |
| | 45 | 40 | 4·52 | |
| | 46 | 25 | 4·57 | |
| | 46 | 35 | 4·50 | |
| | 45 | 40 | 4·52 | |
| | 46 | 10 | 4·48 | |
| | 46 | 30 | 4·27 | |
| Means | 46 | 5 | 4·49 | |
| June 8 | 47 | 47 | 4·2 | Moderately steady; one disk seems about ⅓ more in diameter than the other; telescope 11½; power 544. |
| | 48 | 0 | 3·81 | |
| | 47 | 52 | 4·30 | |
| | 47 | 10 | 4·23 | |
| | 48 | 28 | 4·70 | |
| | 47 | 42 | 4·41 | |
| | 48 | 15 | 4·38 | |
| | 48 | 10 | 4·22 | |
| | 48 | 8 | 4·20 | |
| | 47 | 10 | 4·34 | |
| Means | 47 | 52 | 4·20 | |

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| Date. | Position-Angle. | | Distance. | Remarks. |
|---|---|---|---|---|
| 1877 | ° | ′ | ″ | |
| July 5 | 72 | 56 | 2·713 | Aperture 8 inches; power 450; stars dancing; telescope 11½. |
| | 72 | 56 | 2·803 | |
| | 72 | 46 | 2·445 | |
| | 73 | 2 | 2·766 | |
| | 72 | 46 | 2·731 | |
| | 72 | 59 | 2·481 | |
| | 72 | 21 | 2·642 | |
| | 73 | 24 | 2·392 | |
| | 72 | 56 | 2·427 | |
| | 72 | 36 | 2·570 | |
| Means | 72 | 52 | 2·597 | |
| July 7 | 72 | 57 mean | | 6 measures; power 450. |
| | 72 | 31 ,, | | 8 ,, ,, 800. |
| July 20 | 78 | 57 | 1·818 | Telescope on west side of pier; star 2 hours before meridian; definition not good; aperture 5 inches; power 500; telescope 11½. |
| | 79 | 40 | 2·179 | |
| | 80 | 25 | 2·161 | |
| | 80 | 40 | 1·999 | |
| | 79 | 33 | 2·179 | |
| | 79 | 15 | 1·999 | |
| | 78 | 40 | 2·089 | |
| | 78 | 7 | 2·071 | |
| | 79 | 28 | 2·071 | |
| | 79 | 45 | 2·143 | |
| Means | 79 | 27 | 2·071 | |
| July 24 | 75 | 40 | 2·269 | Aperture 7 inches; power used 800; telescope on east side; star 2 hours past meridian; telescope 11½ inches. |
| | 76 | 30 | 2·071 | |
| | 75 | 55 | 2·125 | |
| | 75 | 35 | 2·071 | |
| | 76 | 12 | 2·287 | |
| | 75 | 45 | 2·105 | |
| Means | 75 | 56 | 2·155 | |

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| Date. | Position-Angle. | Distance. | Remarks. |
|---|---|---|---|
| 1877 | ° ′ | ″ | |
| July 25 | 76 50 | 2·089 | Aperture 5 inches; power 800; telescope on east side of pier; definition not very good; stars dancing. Great care taken with these observations, but the position-angle is very difficult, owing to the motion or unsteadiness of the stars. Clouds were passing, and at times obscured both stars, but oftener only $\alpha^2$, which I estimate as fully one-third, or nearly one-half, less than $\alpha^1$. The varying thickness of the clouds enabled me to estimate the relative brilliance. |
| | 75 0 | 2·197 | |
| | 77 35 | 2·089 | |
| | 77 3 | 2·197 | |
| | 76 28 | 2·161 | |
| | 76 5 | 1·927 | |
| | 76 20 | 1·999 | |
| | 75 20 | 2·053 | |
| | 77 40 | 2·215 | |
| | 77 30 | 2·143 | |
| | 76 30 | 2·179 | |
| | 75 15 | 2·017 | |
| | 76 10 | 2·251 | |
| | 75 30 | 2·071 | |
| Means | 76 22 | 2·113 | |

*Sydney Observatory,*
*July* 27, 1877.

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## *Observations of the Lunar Eclipse*, 1877, *August* 23. By the Rev. Samuel J. Johnson.

The total eclipse of the Moon was seen here as well under an English as under an oriental sky, not a cloud intervening throughout. I employed a power of 70 on 2¼ in.

9.10 Penumbra dimmed the N.E. quadrant of the Moon considerably. At 8.45 I had not been able to satisfy myself about the presence of it. Precise time of commencement difficult to determine. At 9.15 the shadow was evidently impinging on the neighbourhood where *Olbers* is marked.

9.18½ Immersion of *Grimaldi.*

9.22½ Shadow reached *Aristarchus.*

9.32¾ *Copernicus* reached. For 3 min. or 4 min. an orange tint has been visible at the edge of the Moon. *Aristarchus* comes out most distinctly in the shadow.

9.39¾ *Plato* reached.

9.40¾ *Archimedes* reached.

9.49¼ *Tycho* reached. *Aristoteles* same time. Copper tint readily seen with unassisted vision.

9.51 Immersion of *Tycho.*

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9.55 The three $\psi$'s in *Aquarius* coming into view to the naked eye.

10.5 So-called seas in the eclipsed Moon beginning to be very prominent. *Mare Serenitatis* standing out nearly black, darker than any other part of the lunar surface.

10.13$\frac{1}{4}$ Immersion of *Mare Crisium. Mare Crisium, Mare Fœcunditatis,* and the region south of them of a greenish hue. The rest of the eclipsed disk of a coppery tint.

10.18·2 Emersion of a star about mag. 7$\frac{1}{2}$ from a point in a line with south extremity of *Mare Crisium.* Angle about 100°.

10.20 Total obscurity.

10.24·9 Star mag. 7 occulted, angle about 80°. It exhibited the illusion of projection more plainly than I have ever noticed, appearing to lie within the Moon's limb $3^{s}$ or $4^{s}$.

11.8·0 Emersion of small star mag. 8. Angle about 110°.

11.15 The central regions darkest, being about the time of mid-eclipse; the illumination round the borders tolerably uniform now.

11.45 Crescent of yellow light on Moon's eastern limb. *Mare Crisium, Fœcunditatis, Nectaris, Tranquilitatis, Serenitatis* in a smoky gloom; above and below this region the prevailing tint orange.

12.4$\frac{1}{4}$ First streak of sunlight. This outbreak was so clearly marked that it might have been noticed by the naked eye within $3^{s}$ or $4^{s}$ of the instant the telescope showed it.

12.7$\frac{1}{4}$ Emersion of *Grimaldi.*

12.14$\frac{1}{4}$ Emersion of *Aristarchus.*

12.27$\frac{1}{2}$ Emersion of *Copernicus.*

12.30$\frac{1}{2}$ Emersion of *Plato.*

12.31$\frac{1}{4}$ Emersion of *Tycho.*

12.35 Emersion of *Archimedes.* Milky Way beginning to fade out of sight, now half the Moon is uncovered.

A slight brownish tinge mingling with the grey could be detected until 12.55.

13.0$\frac{3}{4}$ *Mare Crisium* began to emerge.

13.5 Emersion of the *Mare Crisium.*

A few degrees north of this, the shadow left the Moon about 13.8$\frac{1}{2}$.

(Angles of Stars occulted reckoned same way as in *N.A.*)

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There was an absence of that flickering light on the reddened disk of the Moon which I noticed last February, and which was probably due simply to the undulations of our own atmosphere, but which Professor Dorna of Turin ascribed to the action of a lunar aurora, saying that the refraction of the Sun's rays within the cone of the Earth's shadow was not an adequate explanation. (See *L'Opinione Nazionale*, March 3).

I had requested another observer, only 35 sec. long. further east than here, to note the time of the first outbreak of sunlight on the Moon, as a simultaneous observation, and the result gave a difference of longitude almost precisely accurate.

*Upton Helions Rectory, Crediton.*

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## *On the Spectrum of Comet b 1877 (Winnecke's) and of the Eclipsed Moon, observed at the Royal Observatory, Greenwich.*

(*Communicated by the Astronomer Royal.*)

The position of Comet *b* 1877 was so inconvenient for observation with the Great Equatoreal when armed with the long Single Prism Spectroscope, that it was found practically impossible to obtain any measures of the bands in the Spectrum, though on May 15 the Dun Echt Observations (*Monthly Notices*, 1877, June) were so far confirmed that the spectrum of the coma was found to consist of three bands in the neighbourhood of the three principal carbon bands, wave-lengths 4834, 5203, and 5607, whilst that from the nucleus appeared to be continuous. For more exact determination of position, a small Half Prism Spectroscope, giving a dispersion of 20° from A to H with a magnifying power of 9 on the viewing telescope, was used, and this, being only 16 inches in length and consequently much shorter than the other spectroscope, allowed sufficient room for the observer within the polar axis. With this greater dispersion the spectrum of the nucleus no longer appeared continuous, and the wave-length of the brightest band was determined (by six indirect comparisons with the carbon band 5203) to be 5178, with a probable error of 5 tenth-metres. The measures were made by turning the half-prism by means of a screw, so as to bring the cometary band to coincide with the bright reference line formed by the image of the comet on the slit, and then comparing the latter with the band in the carbon spectrum.

During the Eclipse of the Moon on 1877 August 23, the spectrum was observed with the Single Prism Spectroscope during totality and also during the partial phase, when the portion of the Moon's disk still in the umbra was repeatedly compared with the part which had emerged. During totality (about $11^h$ G.M.T.) a strong absorption band was seen in the yellow, and the red and blue ends of the spectrum were

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completely cut off, whilst the orange was greatly reduced in intensity. The yellow and green were comparatively bright, and in fact appeared at a first glance to constitute the whole visible spectrum. The wave-length of the more refrangible edge of the strong absorption band was found, from a mean of 9 measures, to be 5624 ± 5, and at about $11^h$ it extended to wave-length 5900, i.e. as far as D. As the end of the total phase approached ($12^h\ 4^m$), the band became narrower, its breadth being only twice the interval of the D lines at $11^h\ 45^m$, and at $12^h\ 20^m$, during the partial phase, it was reduced to a mere line on the eclipsed portion. This band is coincident with the strong band $\delta$ of the atmospheric spectrum as given by Brewster and Gladstone, which is peculiarly characteristic of the spectrum of light which has passed through a thick stratum of air. The red end of the spectrum was cut off by a dark band commencing about halfway from D to C, in which a black line was suspected. About the middle of totality a dark band, commencing at 5080 ± (near band $\iota$ of the Brewster-Gladstone spectrum) cut off all the rest of the spectrum, but later on at $11^h\ 30^m$ the spectrum was visible as far as about 4930 (the position of band $\kappa$ in the atmospheric spectrum). After the end of totality the red and blue ends of the spectrum from the eclipsed portion became visible beyond these limits. The appearance of the spectrum of the part clear of the umbra, though still in the penumbra, was totally different, even when reduced to the same degree of faintness by closing the slit. In this case the spectrum faded out as a whole from beyond D to near G in the violet.

The part of the Moon examined when the band $\delta$ was darkest was the region of *Mare Nectaris* and *Mare Fœcunditatis*, and the band could be seen only on the darkest part of the Moon when *Kepler* was just emerging from the umbra, growing rapidly fainter as the spectroscope was moved away towards the bright part.

The light by which the eclipsed Moon is visible would thus appear to have passed through a great thickness of the earth's atmosphere, giving rise to the peculiar copper colour.

The observations were made by Mr. Christie and Mr. Maunder.

*Royal Observatory, Greenwich,*
1877, *August* 28.

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